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1		Cog. Mgr. G. C. Henckel III	[signature]		H6-04	RRSA J. J. Zimmer	[signature]	9/1/93	H4-67	1	
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7. Abstract

This safety assessment addresses the hazards associated with storage of contaminated soil from a liquid waste disposal site on a temporary or semipermanent basis.

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CONTENTS

1.0 INTRODUCTION AND SUMMARY 1

2.0 WORK SCOPE 1

3.0 HAZARDS INVENTORY 2

4.0 NATURAL PHENOMENA 3

5.0 POTENTIAL ENERGIES OF CONCERN 4

6.0 SITE DESCRIPTION 4
6.1 REGIONAL BACKGROUND 4
6.2 LOCATION AND DESCRIPTION 5

7.0 HAZARDS ASSESSMENT 5

8.0 OPERATIONAL SAFETY LIMIT 11

9.0 REFERENCES 12

APPENDIXES

A SUPPORTING CALCULATIONS A-1
B SAFETY CLASSIFICATION OF TERRASTOR STORAGE UNIT B-1
C DESIGN CALCULATIONS C-1

TABLES

1 116-F-4 Pluto Crib Radionuclide 3
2 Airborne Concentration Of Radionuclides 10
3 Hazard Threshold Values 10

FIGURES

1 Orientation of the Hanford Site 6
2 Location of 100-F Area 7
3 Expanded View of 100-F Reactor Area 8
4 Siting Within the 100-F Area 9

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SAFETY ASSESSMENT FOR STORAGE OF CONTAMINATED SOIL AT THE 100-F AREA

1.0 INTRODUCTION AND SUMMARY

Westinghouse Hanford Company (WHC) is responsible for managing the investigation, characterization, and remediation of the Hanford Site for the U.S. Department of Energy. For environmental restoration (ER) and decontamination and decommissioning (D&D) remediation activities that involve large quantities of soil, it may become necessary to store contaminated soil on a temporary or semipermanent basis. This safety assessment addresses the hazards associated with storage of contaminated soil from a retired liquid waste disposal (LWD) site under these conditions.

The ER projects involving removal of contaminated soil from a crib, trench, ditch, or pond may subject soil to storage on an interim basis during excavation, characterization, processing, or disposal phases of a particular project. Earth-moving equipment (such as backhoes) will be employed to move quantities of soil from the project site to transport vehicles that will transport the soil to a processing unit. Depending on the process, soil may be stored to await characterization, transport, processing, or after processing if contaminants of concern were not fully addressed.

A temporary soil storage unit has hazards associated with any soil activity. These hazards are a function of hazardous material quantity and credible mechanisms available that could disperse these materials. Resuspension of contaminants by credible mechanisms such as wind erosion, loss of confinement, and biointrusion have been identified. Contaminants of concern include a variety of radiological and chemical species identified at the Hanford Site. Concentrations of radionuclides typically are in the nCi to pCi per gram range. Chemicals in Hanford Site soil are generally in the parts per million or parts per billion range. There are locations at the Hanford Site where these levels are exceeded, but those locations are not included in the scope of this assessment.

The storage unit project evaluated in this assessment has been categorized as a low hazard activity in accordance with the criteria provided in WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*. Review and authorization levels are anticipated to be commensurate with this hazard classification (DOE 1986). Requirements for control of soil that exceed minimum levels will be provided in the following work procedures: Job Safety Analysis, Radiation Work Permits, Hazardous Waste Operations Permit, and applicable procedures in WHC-CM-7-5, *Environmental Compliance Level* , WHC-CM-7-7, *Environmental Investigations and Site Characterizations Manual*, and WHC-CM-4-40, *Industrial Hygiene Manual* . This safety assessment satisfies the requirements of DOE Order 5481.1B, *Safety Analysis and Review System* (DOE 1986).

2.0 WORK SCOPE

Engineered containment systems provide storage of radiological and chemically contaminated soil pending resolution of characterization or processing requirements. The objective of this activity is to store contaminated soil from inactive *Comprehensive Environmental Response Compensation and Liability Act of 1980* (CERCLA) LWD sites in a TerraStor[1] modular-constructed containment unit near the excavation site. Based upon the most limiting component of the unit, its outdoor life will not exceed five years.

Soil from the LWD sites will be transferred to the containment unit via truck, backhoe, or other mechanized methods. Soil would be contained in a maximum size 27 m by 27 m by .6 m (90 ft by 90 ft by 2 ft) unit; however, because of specific applications here at the Hanford Site, and the modular design, the unit may be constructed on a smaller scale.

The unit will have an underlayment of 100 mil geotextile and a 30 mil polyvinyl chloride (PVC) liner will be placed over it. The PVC liner has a life of five to seven years, therefore limiting components as the cover may be replaced at a later date. The unit will be covered with a 12 mil polyethylene laminate cover that has an outdoor life of approximately four to five years.

The selected excavation and storage site is the 116-F-4 Pluto Crib, located at the southern perimeter fence, within the 105-F Reactor Building exclusion area fence. The crib is approximately 36 m (120 ft) southwest of the 105-F Reactor Building. The TerraStor storage unit will be located within the fenced exclusion area for control purposes.

The excavation area is estimated to contain 3.44×10^6 L (4,500 yd^3) of potentially contaminated soil, with 3.44×10^5 L (450 yd^3) of that volume estimated to be contaminated with radioactive nuclides from fuel cladding failures. Clean soil will be stockpiled and used for backfill after completion of the storage activities and verification that all contaminants have been removed from the excavation area..

3.0 HAZARDS INVENTORY

Inventories of concern for the 116-F-4 Pluto Crib were associated with aqueous waste containing radioactive nuclides and chemical constituents from fuel cladding failures during operation of the 105-F Reactor Building. From 1952 to 1953, it is estimated 4,001 L (1,057 gal) of contaminated water was discharged into a 3 m by 3 m by 3 m (10 ft by 10 ft by 10 ft) pit that was later designated as the 116-F-4 Pluto Crib.

Table 2 lists the radionuclides from the potentially contaminated soil column in the 116-F-4 Pluto Crib.

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[1]TerraStor is a registered trademark of ModuTank, Inc., Long Island City, New York.

Table 1. 116-F-4 Pluto Crib Radionuclide.

Radionuclide	Average pCi/g	Curies
^{238}Pu	4.7 E-01	5.6 E-04
$^{239/240}Pu$	3.5 E+01	4.2 E-02
^{90}Sr	1.1 E+03	1.3 E+0
^{3}H	1.4 E+03	1.7 E-02
^{152}Eu	8.9 E+0	1.1 E-02
^{60}Co	4.7 E-01	5.6 E-04
^{154}Eu	4.0 E+01	4.8 E-02
^{134}Cs	2.1 E+01	2.5 E-02
^{137}Cs	1.6 E+03	1.9 E+0
^{155}Eu	9.4 E+01	1.1 E-01
U	1.3 E+0	1.6 E-03
Total curies = 3.5		

The potential chemical contaminant of concern is chromium, originating as an algicide in the cooling water. It is estimated that .004 kg (4 g) of sodium dichromate was disposed into the 116-F-4 crib during operations. The percent by mass of chromium would therefore be 0.002 kg (1.59 g); this information was obtained from the Waste Information Database System (WIDS). The WIDS is controlled and maintained by WHC. The amount of chromium would not pose a hazard to involved facility workers. In addition, the hexavalent state of the most restrictive chromium ion will react with other constituents in the sodium dichromate soil column site.

4.0 NATURAL PHENOMENA

The effect of natural phenomena was assessed relative to the activities involving excavation and storage of contaminated soil from retired LWD sites. Natural phenomena events such as floods, tornadoes, and lightening would not have significant adverse effects that would increase the hazards associated with storage activities. Statistics and probability scopes for these events at the Hanford Site are provided in Lehrschall (1992).

High wind speeds up to 180 km/hr (112 mi/hr) have been determined to be credible for the Hanford Site (>10 x 10^{-6}) (Kennedy et al. 1990). Normal wind speeds of 4.8 km/hr (3.0 mi/hr) were found not to have an effect. An analysis at the BX-102 site involving a fractional release of the highest concentrations of radionuclides from three drive barrels exposed to a 24 km/hr (15 mi/hr) wind for 1 hour and 8 hour found the consequences to the onsite worker and the public to be insignificant (Lehrschall 1992). TerraStor installation activities would be expected to encounter concentrations of nuclides in nCi to pCi per gram range versus the uCi/g concentrations at the

BX-102 site. The 24 km/hr (15 mi/hr) wind speed is the maximum wind speed under which outdoor work activities are allowed. Missiles generated by high winds could generate hazards to workers or damage support equipment; however, because of the type of activities performed, high winds would not lead to surface spills or airborne releases. The consequences associated with high winds/missiles would be bounded by the maximum release event.

5.0 POTENTIAL ENERGIES OF CONCERN

The focus of this assessment is the storage of contaminated soil from retired LWD sites. The energies necessary to redistribute those soil in a manner that would be detrimental to the health and welfare of the public, the onsite worker, or the environment are discussed in this section.

Credible mechanisms for release of contaminated soil include wind erosion, biointrusion, and failure of containment with subsequent erosion via wind. The system was examined for failure modes induced by a 70 mi/h wind and found to be more than sufficient to withstand the pressures created by this phenomena. Calculations for wind induced pressures indicate that the cover could withstand pressures 50 times greater than those generated by a 70 mi/h wind (Attachment C). Additionally, a crusting agent will be used on the soil impounded in the Terrastor unit. The crusting agent will prevent soil erosion if a cover failure occurs.

These energies could induce transfer of contaminants to other than desirable locations. The transfer of soil from project sites to storage may result in small quantities being lost in transport. However, these quantities will be bounded by the assessment envelope.

Other mechanisms considered were range fires, tornados, floods, seismic events, lightning strikes, and accidents from vehicles. It was postulated that the movement of the maximum concentration of radionuclides would be induced by wind erosion under ideal conditions. Therefore, wind erosion of the maximum soil storage area (unmitigated) will be used as a basis for evaluating the consequences of this storage activity.

6.0 SITE DESCRIPTION

6.1 REGIONAL BACKGROUND

This section provides a categorical list of references for detailed studies on the regional background of the Hanford Site.

- Meteorology - Delaney et al. (1991) and PNL 1990
- Geology - Delaney et al. (1991)
- Hydrogeology - Liikala et al. (1988).

The topography of the Hanford Site is relatively flat although elevations range from greater than 1,000 m (3,300 ft) above mean sea level (msl) at Rattlesnake Mountain to 119 m (390 ft) above msl along the Columbia

River. The 100-F Area is situated along the Columbia River in the northern portion of the Hanford Site with an elevation of 119 m to 143 m (390 ft to 470 ft). The gradient increases slightly away from the river channel.

There are no permanent residents on the Hanford Site. The working population of the 100-F complex varies on a daily basis. Generally, however, the population averages approximately 10 people per day in the area. There are boaters who use the Columbia River for recreation throughout the year and have access to the west and south banks of the river. The nearest public road is State Highway 24, located 8.9 km (5.5 mi) from the 100 F Area. The nearest resident to the 100 F Area is located 8.1 km (5 mi) east of the reactor and across the Columbia River.

The Hanford Site is located in south-central Washington State, approximately 273 km (170 mi) southeast of Seattle and 201 km (125 mi) southwest of Spokane (Figure 1). The site occupies an area of approximately 1,450 km^2 (560 mi^2) within the semiarid Pasco Basin of the Columbia Plateau.

6.2 LOCATION AND DESCRIPTION

This section describes the location of the TerraStor unit with respect to the Hanford Site. Figure 1 provides a basic orientation of the Hanford Site and Figures 2 and 3 provide maps of the 100-F Area. Figure 4 depicts specifically within the 100-F complex where the TerraStor unit will be located.

7.0 HAZARDS ASSESSMENT

The hazard associated with the storage of soil contaminated with radionuclides is potential inhalation of particulates. Therefore, this analysis will focus on the concentrations, mechanisms, and risks associated with particulate inhalation.

It is assumed the storage area will be uncovered and the soil will have a homogenous mixture of contaminants. The soil will be dry with the top centimeter subject to wind erosion. The potential exists for resuspension from transport of soil to storage; however, the total area of the TerraStor storage module unit will present a larger source term for resuspension of particulates. Because the storage area presents the largest area for resuspension of particulates, it will be used as the bounding source term for this assessment. Appendix A provides supporting calculations for the TerraStor storage unit. The safety classification for the unit is provided in Appendix B.

There are no known chemical species for which consideration of source terms would be evaluated. If chemical contaminants are identified during the activities, work will cease until those hazards are evaluated.

Figure 1. Orientation of the Hanford Site.

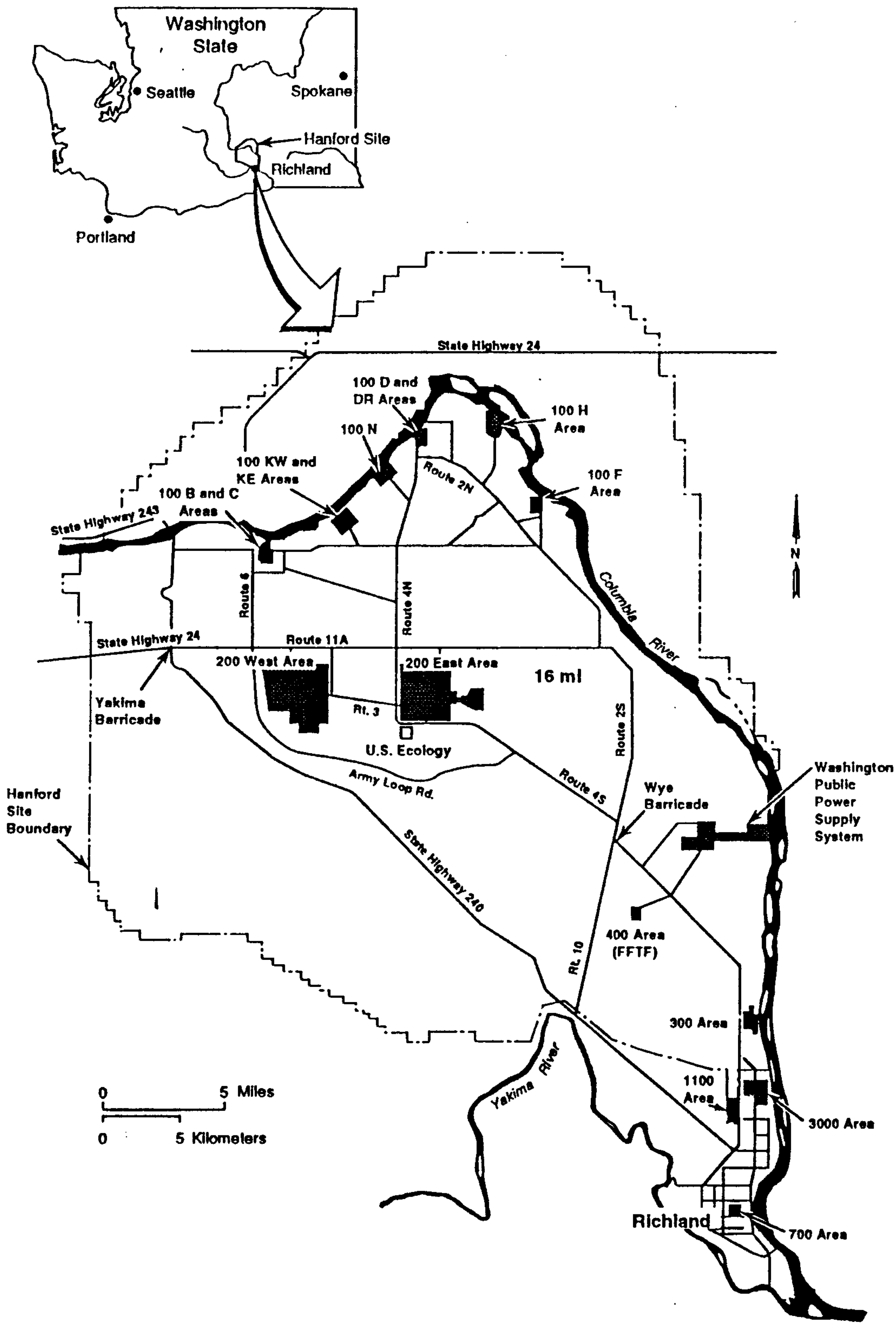


Figure 2. Location of 100 F.

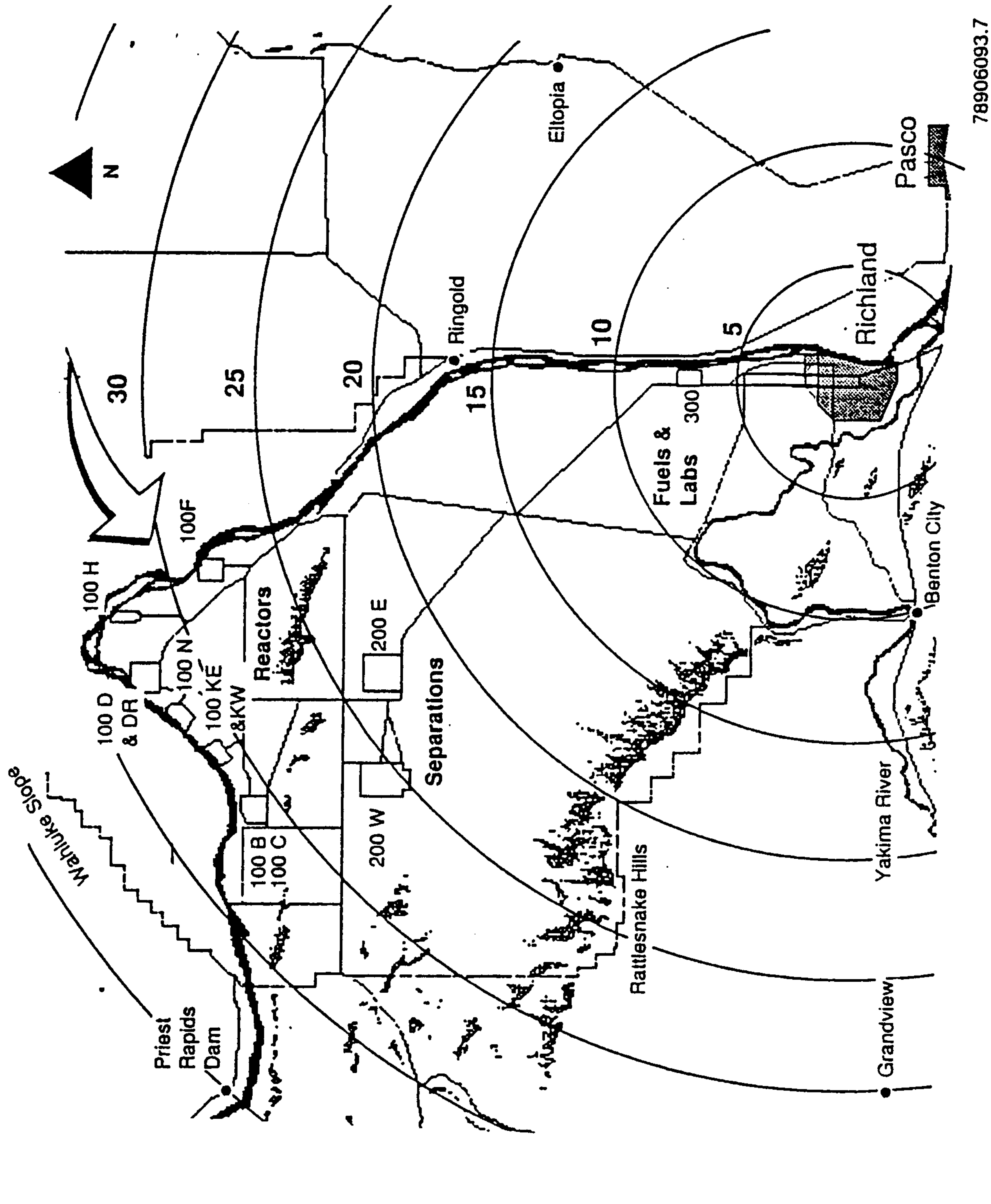


Figure 3. Expanded View of Reactor Area 100 F.

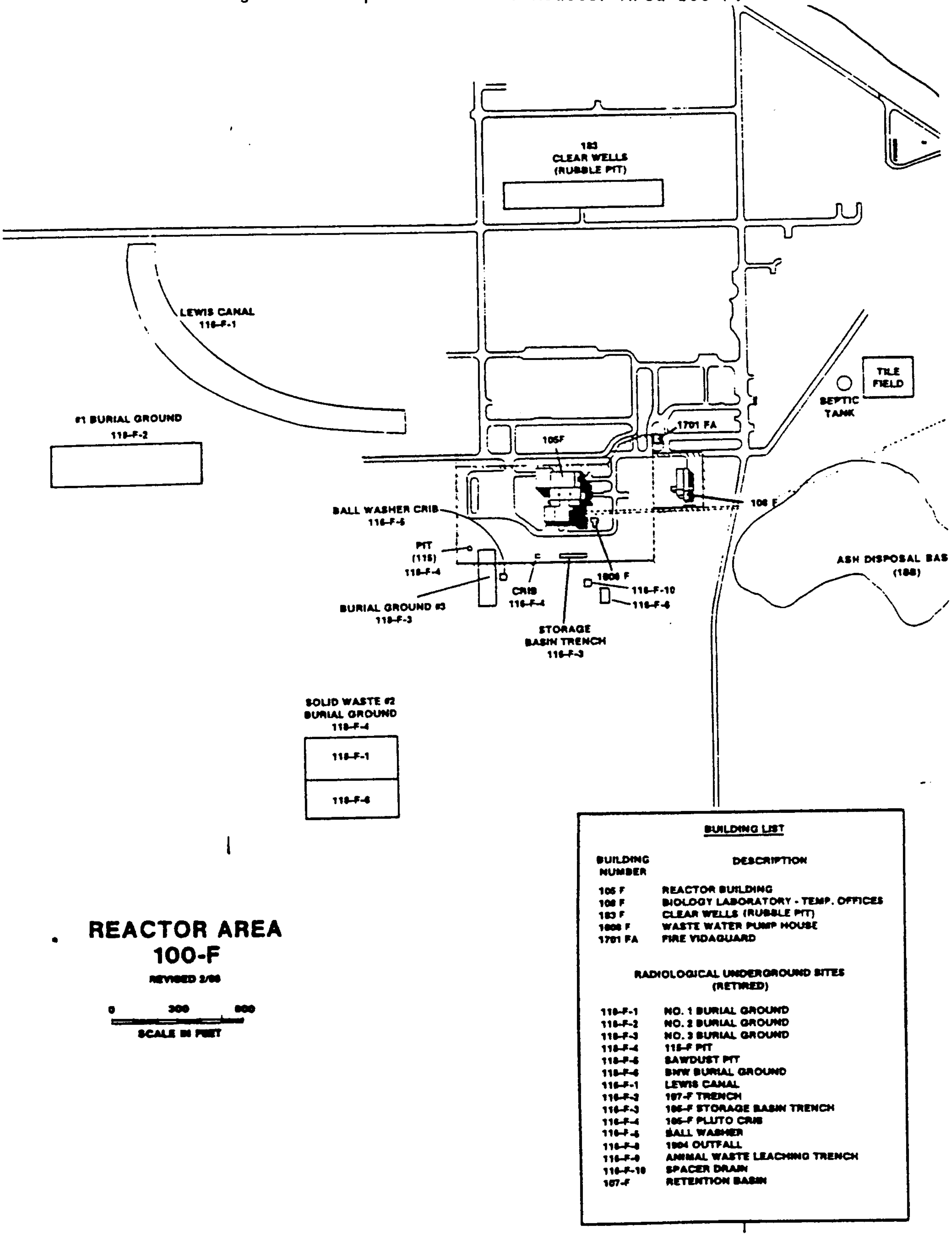
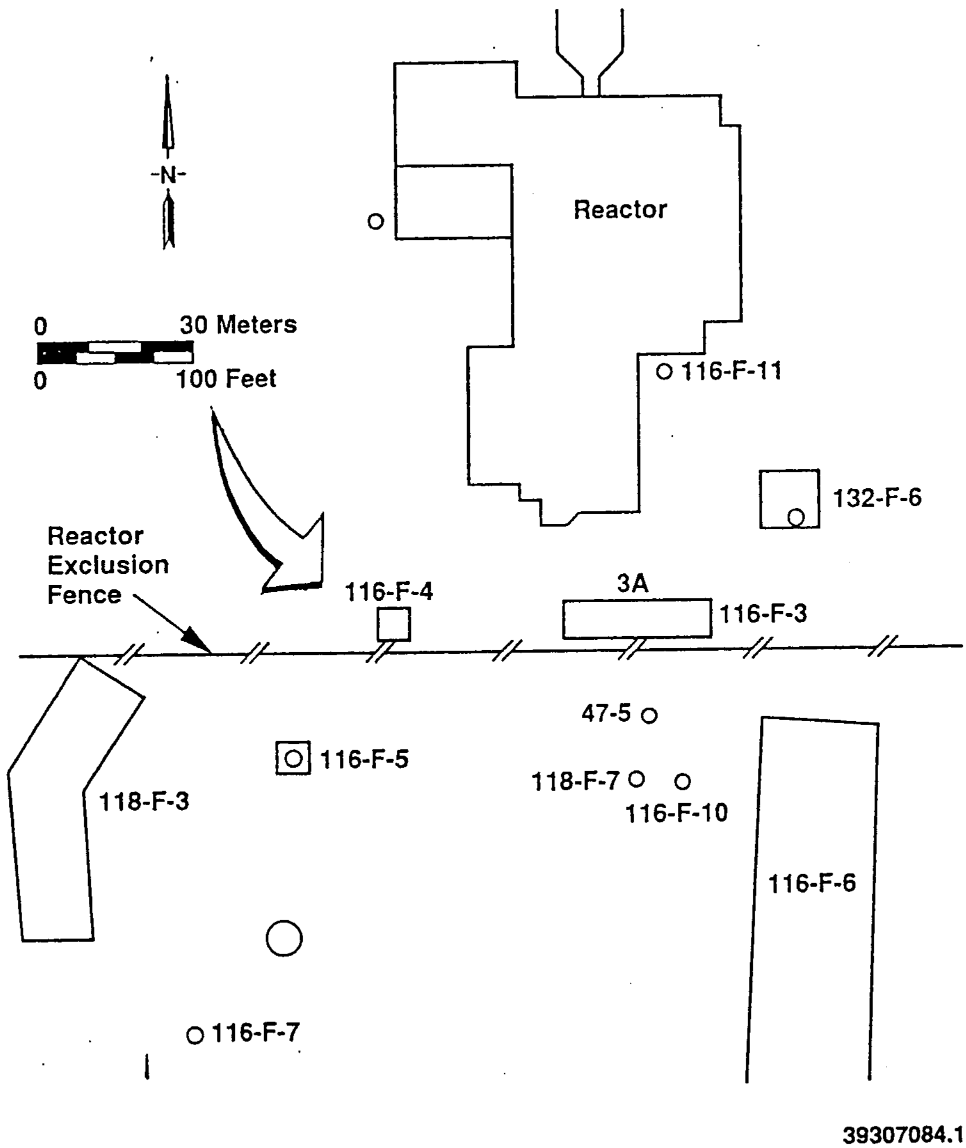


Figure 4. Siting Within the 100 F Area.



The consequences of a resuspension of particulates are listed below in Table 2. Table 3 lists the upper limits for low hazard operation in accordance with WHC-CM-4-46. The derived air concentration guides (DAC) value applies to facility workers, and is based upon an annual estimated dose equivalent (EDE) of 5 rem. The derived concentration guides (DCG) value applies to the public and is based upon an annual EDE of 0.1 rem. Therefore, at 100 m (330 ft), using the most conservative model available, the air concentration for the most limiting isotope within the storage unit would not reach a DCG level requiring public concern. Consequently, exposure to site workers, uninvolved site workers, and the public would be well below the upper limit of risk for low hazard activities as specified in WHC-CM-4-46.

Table 2. Airborne Concentration Of Radionuclides.

Nuclide	Concentration at 100 m (330 ft) in uCi/cc	DAC value in uCi/cc	DCG value in uCi/cc
^{90}Sr	1.9 E-11	2.0 E-9	9.0 E-12
^{137}Cs	2.77 E-11	7.0 E-8	4.0 E-10

Table 3. Hazard Threshold Values.

Hazard category	Facility worker	Onsite	Offsite
General use			
Radiological	<Exempt quantity	--	--
Chemical	none listed	<0.1 IDLH	<0.01 IDLH
Low hazard			
Radiological	≥Exempt quantity <25 rem	≥0.1 rem <5.0 rem	≥0.01 rem <0.5 rem
Chemical	none listed	≥0.1 IDLH	≥0.01 IDLH

IDLH = immediately dangerous to life or health.

The Emergency Prediction Information[2] program model has generated data that confirms the potential for ingestion of radiological particulates is low and the storage of soil in the unit constitutes a low hazard activity. The risk is well within the low hazard regime and will not pose an unacceptable threat to the public, workers, or the environment. Although the program model assumes unmitigated circumstances, the suppression of soil to prevent dispersion by wind erosion will be incorporated into the operational safety limit (OSL) to further lower the potential for lofting particulates.

[2]Emergency Prediction Information is a registered trademark of Homann Associates, Inc., Fremont, California.

8.0 OPERATIONAL SAFETY LIMIT

The following required safety function limits the potential for resuspension of particulates from the storage site and will assure the limits for occupational safety are not exceeded. The function encompasses monitoring for control purposes and administrative documentation to ensure requirements are met. By implementation of a safety function, the safety envelope of this assessment will remain a low hazard activity, thereby assuring compliance with DOE directives.

Operational Safety Limit 1 - Dust Suppression of Soil

1.0 Title - Limiting the Potential for Resuspension of Particulates.

1.1 Applicability - This OSL applies to potentially contaminated soil removed from LWDS.

1.2 Objective - To assure the storage of LWDS soil inventories are controlled, and the potential for resuspension of particulates is minimized from these sites.

1.3 Requirements -

a. Dust suppression techniques shall be used to prevent resuspension of contaminants (e.g., water, sarfactents, crusting agents, and covers).

b. The responsible safety officer or field team leader will assure that appropriate personnel are available for monitoring and controlling soil inventory.

1.4 Surveillance - The responsible operating organization shall verify daily during operation and at least weekly (plus or minus one day) during interim storage that the project site is in compliance with the requirements of this OSL. Surveillance data results shall be documented in an auditable log or Field Activity Report (FAR).

1.5 Recovery -

1.5.1 Noncompliance with the Requirements of the Operational Safety Limit

a. If field surveys indicate migration of contaminants from the storage area, activities shall stop and the area shall be stabilized.

b. If dust suppression techniques are not available, activities shall stop and stabilization methods shall be implemented.

c. In the event monitoring support is not available at the project site, work shall immediately cease; notification to appropriate line and health physics management is required. Monitoring support is required before restart of operations with concurrence of the site safety officer and health physics.

d. The OSL violation shall be documented as required by WHC-CM-1-3, *Management Requirements and Procedures*.

1.5.2 Noncompliance with Surveillance Requirement

a. Surveillance shall be performed immediately.

b. If the surveillance indicates noncompliance with the requirements in Section 1.3 of this OSL , the recovery action in Section 1.5.1 shall be implemented.

c. Failure to document the surveillance requirement shall be documented as required by WHC-CM-1-3.

1.6 Audit Point - An auditable log or FAR shall be maintained to document the results of surveillances. This log should be reviewed weekly by the operations organization to assure compliance with the OSL.

1.7 Basis - Compliance with these OSL requirements will assure the safety scope of this assessment is maintained and activities will remain a low hazard.

9.0 REFERENCES

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U. S. C↓ 9601 et seq.

DOE, 1986, *Safety Analysis and Review System*, DOE 5481.1B, U.S. Department of Energy, Washington, D.C.

Kennedy, R. P., S. A. Short, J. R. McDonald, M. W. McCann, R. C. Murray, J. R. Hill, 1990, *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, UCRL-15910, U. S. Department of Energy, Washington, D. C.*

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Liikala, T. L., R. L. Aaberg, N. J. Aimo, D. J. Bates, T. J. Gilmore, E. J. Jensen, G. V. Last, P. L. Oberlander, K. B. Olsen, K. R. Oster, L. R. Roome, J. C. Simpson, S. S. Teel, and E. J. Westergard, 1988, *Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins*, PNL-6728, Pacific Northwest Laboratory, Richland, Washington.

PNL, 1990, *Climatological Summary of Wind and Temperature Data for the Hanford Meteorology Monitoring Network*, PNL-7471, 1990, Pacific Northwest Laboratory, Richland, Washington.

WHC-CM-4-40, *Industrial Hygiene Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-7-5, *Environmental Compliance*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-7-7, *Environmental Investigation and Site Characterizations Manual*, Westinghouse House Hanford Company.

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APPENDIX A

SUPPORTING CALCULATIONS

TerraStor tank dimensions are

90 ft by 90 ft by 2 ft = 16,200 ft^3 or 600 yd^3.

The volume of soil in the 116-F-4 Pluto Crib is

20 ft by 20 ft by 25 ft = 10,000 ft^3 or 370.37 yd^3.

The volume of the top centimeter of soil subject to resuspension is

90 ft by 90 ft by 0.0328 ft = 266 ft^3.

The area of the top centimeter of soil subject to resuspension is

90 ft by 90 ft = 8,100 ft^2.

Where the area of the circle is

$$1/4 \text{ pi } D^2 = \text{area}$$

$$8{,}100 \text{ ft}^2 = 1/4 \text{ pi diameter}^2$$

$$\frac{8{,}100 \text{ ft}^2}{1/4 \text{ pi}} = \text{diameter}^2$$

$$101.6 = \text{diameter}$$

$$1/2 \text{ diameter} = \text{radius}$$

The radius (parameter for model input) is

50.8 ft or 15.5 m.

The wind velocity (parameter for model input) is

13 mi/hr or 5.8 m/s.

The conversion of the top centimeter of soil to grams is

266 ft^3 = 7.53 E^6 cm^3.

(7.53 E^6 cm^3) x (2 g/cm^3) = 1.5 E^7 g of soil subject to resuspension.

The release rate (parameter for model input) is

(1.5 E^7 g) x (3.5 E^{-6}) = 5.2 E^1 g/s.

The average concentration of nuclides in soil is

^{137}Cs 1.6 E^3 pCi/g or 1.6 E^{-9}Ci/g

^{90}Sr 1.1 E^3 pCi/g or 1.1 E^{-9}Ci/g.

The fraction of specific activity is

$$\text{Sr } \frac{1.1\ E^{-9}\ \text{Ci/g in soil}}{2.78\ E^{2}\ \text{Ci/g (specific activity)}} = 4.0\ E^{-12}$$

$$\text{Cs } \frac{1.6\ E^{-9}\ \text{Ci/g in soil}}{8.66\ E^{1}\ \text{Ci/g (specific activity)}} = 1.9\ E^{-11}$$

The release rates in grams is

$(4.0\ E^{-12})$ x (52 g/s) = 2.08 E^{-10} g/s Sr

$(1.9\ E^{-11})$ x (52 g/s = 9.88 E^{-10} g/s Cs.

The conversion of mg/m^3 in air back to uCi/cc in air is explained in the following example.

^{90}Sr at 100 m concentration in air equals 6.7E^{-11} mg/m^3

$$\frac{6.7\ E^{-11}\text{mg/m}^3}{1.0\ E^{6}\ \text{cc/m}^3} = 6.7\ E^{-17}\ \text{mg/cc}$$

(6.7 E^{-17} mg/cc) x (1 g/1000 mg) = 6.7 E^{-20} g/cc of ^{90}Sr in air.

The specific activity of ^{90}Sr is 2.78 E^2 Ci/g; therefore

(6.7E^{-20} g/cc) x (2.78 E^2 Ci/g) = 1.9 E^{-17} Ci/cc of ^{90}Sr in air or

1.9 E^{-11} uCi/cc.

The DAC for ^{90}Sr equals

2.0 E^{-9} uCi/cc in air.

The DCG for ^{90}Sr equals

9.0 E^{-12}uCi/cc in air.

APPENDIX B

SAFETY CLASSIFICATION OF TERRASTOR STORAGE UNIT

Westinghouse Hanford Company

WHC-SD-EN-SAD-026, REV. 0

Internal Memo

From: Risk Assessment Technology 29220-93-026
Phone: 6-9236 H4-65
Date: June 14, 1993
Subject: SAFETY CLASSIFICATION OF TerraStor CONTAINMENT SYSTEM TO BE USED FOR THE 100 AREA EXCAVATION TREATABILITY TEST PLAN

To: J. A. Locklair H4-67

cc: M. D. Zentner H4-65
File/LB

Reference: (1) *Safety Classification of Systems, Components and Structures*, WHC-CM-1-3, MRP 5.46, Rev. 4

The TerraStor containment system is a Safety Class 3 structure when utilized for the "100 Area Excavation Treatability Test Plan". The containment will be susceptible to wind and/or vehicle damage. Material resuspension and release to the environment could occur.

The volume of material represents an extremely low hazard to personnel. The low quantity of radioactive material and conditions needed for a release represent more of a dust problem. The Adverse Environmental Impact for Safety Classification, Reference 1, Appendix C, was calculated to less then 500,000 or Safety Class 3.

This evaluation is only for use of the TerraStor containment system as part of the 100 Area Excavation Treatability Test Plan and any other use of the system must be evaluated for safety classification.

Documents reviewed:

1. DOE/RL-93-04,Decisional Draft, 100 Area Excavation Treatability Test Plan
2. ModuTank Inc., TerraStor Details

N. L. Wilson
N. L. Wilson
Advanced Engineer

sl

54 7400-081

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APPENDIX C

DESIGN CALCULATIONS

Westinghouse Hanford Company **Internal Memo**

From: Facility Systems Engineering JSB-23450-93-003
Phone: 2-0696 H5-58
Date: June 10, 1993
Subject: 100 AREA SOIL HOLDING CONTAINER

To: L. M. Bergman H6-05
J. M. Frain H6-04

cc: D. M. Chenault H5-58 DMC
J. I. Dearing H5-72
L. L. Hyde H5-58
J. G. Woolard H6-05
JSB LB/File

The purpose of this letter is to describe the methods and results of the calculation performed to support the 100 Area Excavation Test. Attached are two items: A set of calculations performed to support the selection of a cover material and anchorage; and a letter transmitting the findings of a structural engineer asked to investigate the structural integrity of the container.

The calculations supporting the cover material selection and anchorage were performed assuming a 70 mph wind condition. The loads due to this wind resulted in a uniform pressure of 13 lb/ft^2. The maximum tensile load in the plastic was then found to be 672 lb/ft. It recommended that material XR-5 model 8130 be used in this application. This material has sufficient strength to withstand this load and also has good environmental resistance. Detailed information on this material can be found in the attachments to the calculation.

The letter transmitting the results of the structural integrity investigation can be summarized as: The walls of the storage container are not adequate to support the weight of the excavated soil without back filling the area outside the walls. Also, because of the back fill, the container need not be analyzed for a seismic event. A copy of this letter can be found as Attachment two.

In conclusion, the tank can be used if adequate back filling is performed around the outside of the tank. The cover material should have a seam strength in excess of 672 lb/ft. It is recommended that a sheet of XR-5 (available from both MODUTANK or SEAMANS Inc.), be purchased with dimensions greater than 106 ft X 56 ft. The anchorage scheme for the cover is sketched in the calculations.

Please feel free to call me if you have any questions or concerns.

JS Burgess 6/10/93
J. S. Burgess, Engineer
Component Structural Analysis

ModuTank Inc., Long Island City, New York.

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 1 of 7

(4) Building ______ (5) Rev. ______ (6) Job No. ______

(7) Subject 100 AREA SOIL CONTAINER

(8) Originator J.S. BURGESS Date 6/10/93

(9) Checker L. Hyde Date 6/10/93

(10)

PURPOSE: SELECT THE COVER MATERIAL AND ANCHORAGE METHOD BASED ON A 70 mph. WIND LOAD.

REFERENCES

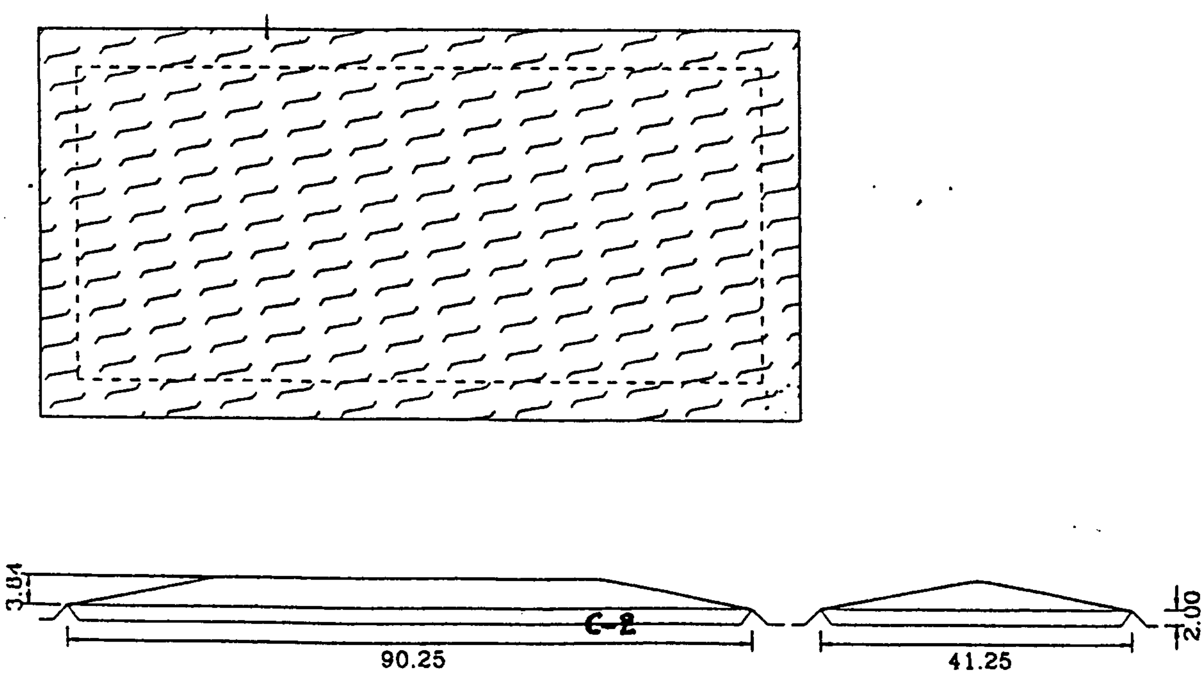
ASCE, 1990, "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES," ANSI/ASCE STANDARD 7-88, AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK,

ESHBACH, O.W., 1956, "HANDBOOK OF ENGINEERING FUNDAMENTALS," WILEY & SONS INC., N.Y.

KOERNER, R.M., 1988, "DESIGNING WITH GEOSYNTHETICS" 2nd EDITION, PRENTICE HALL, NJ.

ROARK, R.J., 1954, "FORMULAS FOR STRESS AND STRAIN," 3rd EDITION, McGRAW HILL, N.Y.

SCHEMATIC

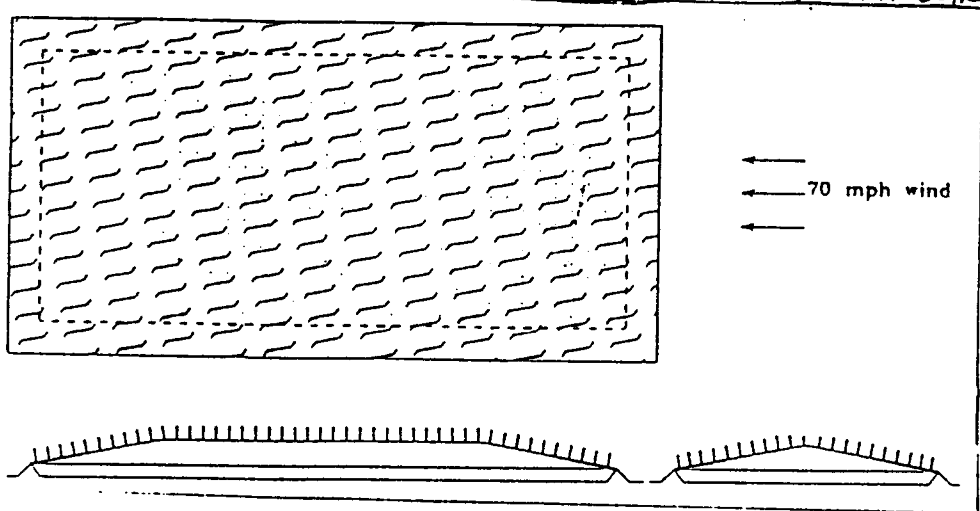


DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 2 of 7
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject 100 AREA SOIL CONTAINER
(8) Originator J.S. BURGESS Date 6/10/93
(9) Checker L. Hyde Date 6/10/93

(10)

CALCULATE LOADS BASED ON 70MPH WIND



USING ANSI/ASCE 7-88 CHAPTER 6.

$p = q_h[(GC_p) - (GC_{pi})]$ (TABLE 4, COMP. & CLAD., h≤60')

$q_h = 0.00256\, K_z (IV)^2$ (eq-3, SEC. 6.5.1)

$K_z = 0.80$ (TABLE 6, EXPOSURE C)

$I = 0.95$ (TABLE 5, CATEGORY IV)

$V = 70\,mph$ (FIGURE 1)

$q_h = 0.00256(0.80)[(0.95)(70)]^2$

$q_h = 9.056768\ psf$

$GC_{pi} = 0.25$ (TABLE 9, CONDITION I) (SEE TABLE 4, NOTE #4 FOR REASON GCp IS + & NOT -)

$GC_p = -1.2$ (FIG. 3, ROOFS, θ≤10°, A≥100ft²)

$p = 9.056768[(-1.2) - (0.25)]$

$p = -13.13\ psf$

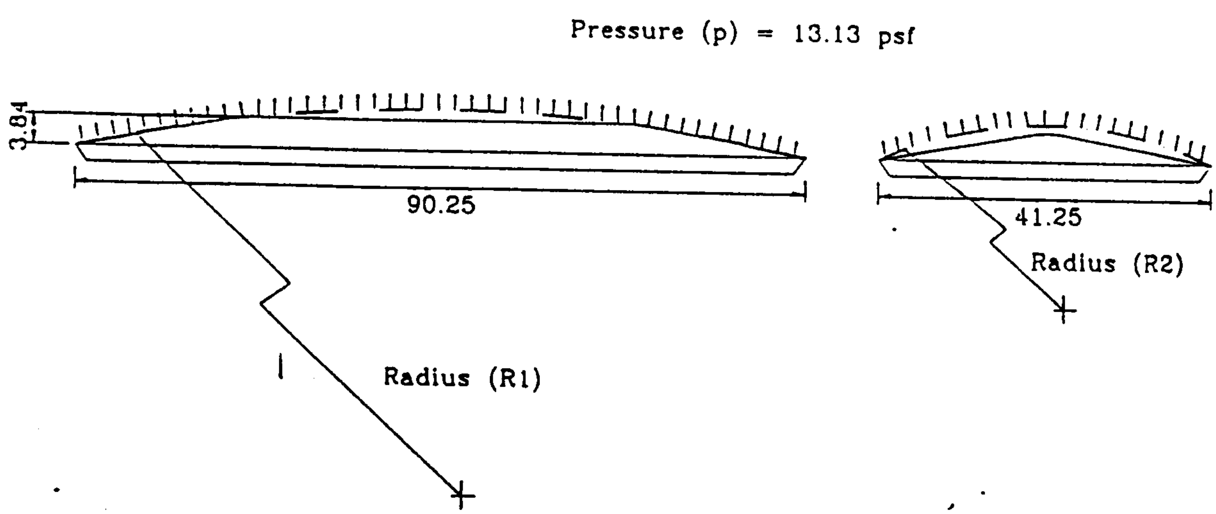
DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 3 of 7
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject 100 AREA SOIL CONTAINER
(8) Originator J. S. BURGESS Date 6/10/93
(9) Checker L. Hyde Date 6/10/93

(10) CALCULATE RESULTANTS IN COVER

MODEL THE COVER AS A SECTION OF AN ELLIPTIC PRESSURE VESSLE.

SCHEMATIC



DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 4 of 7
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject 100 AREA SOIL CONTAINER
(8) Originator J.S. BURGESS Date 6/10/93
(9) Checker L. Hyde Date 6/10/93

(10)

FIND RADII (USING ESHBACH TABLE 1, b, #9)

$$R \cong \frac{4h^2 + l^2}{8h}$$

$$R_1 = \frac{4(3.841)^2 + (90.25)^2}{8(3.841)} \qquad R_2 = \frac{4(3.841)^2 + (41.25)^2}{8(3.841)}$$

$$R_1 = 266.99\text{ft} \qquad R_2 = 57.29\text{ ft}$$

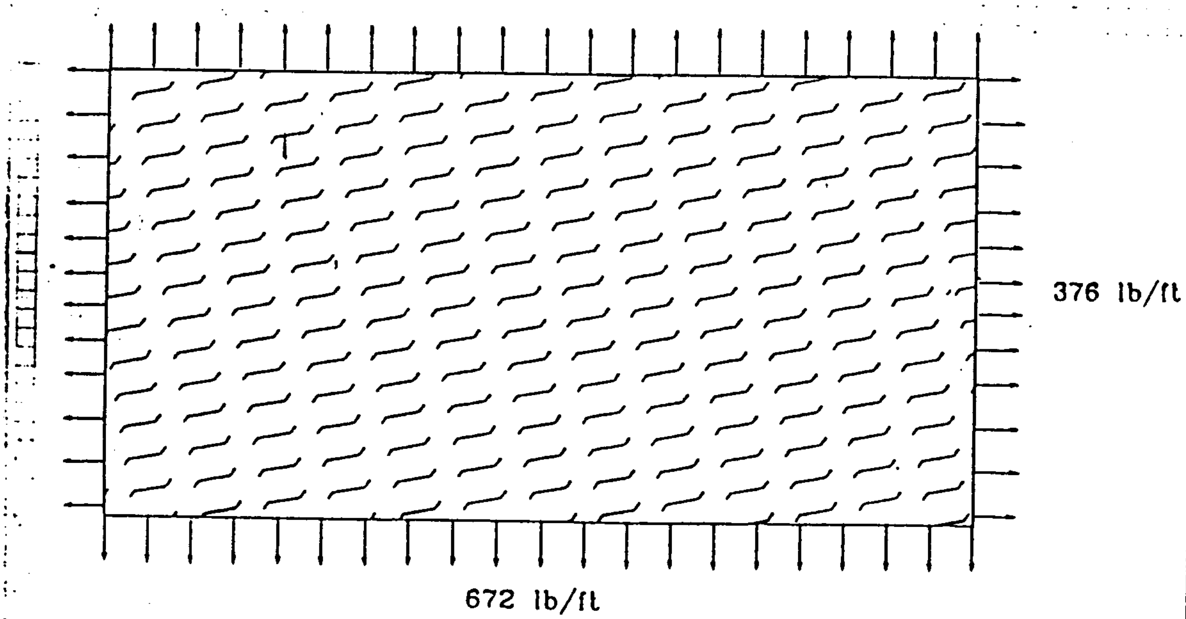
FIND RESULTANTS (USING ROARK TABLE XIII, #5)

$$S_1(t) = \left(\frac{pR_2}{2}\right) \qquad S_2(t) = \frac{pR_2}{2}\left(2 - \frac{R_2}{R_1}\right)$$

$$S_1(t) = \frac{(13.13)(57.29)}{2} \qquad S_2(t) = \frac{(13.13)(57.29)}{2}\left(2 - \frac{57.29}{266.99}\right)$$

$$S_1(t) = 376.11\ \text{lb/ft} \qquad S_2(t) \cong 671.57\ \text{lb/ft}$$

OK



* USE XR-5; SEAM ~~STR.~~ OF 200 lb/in or 2400 lb/ft.

DESIGN CALCULATION

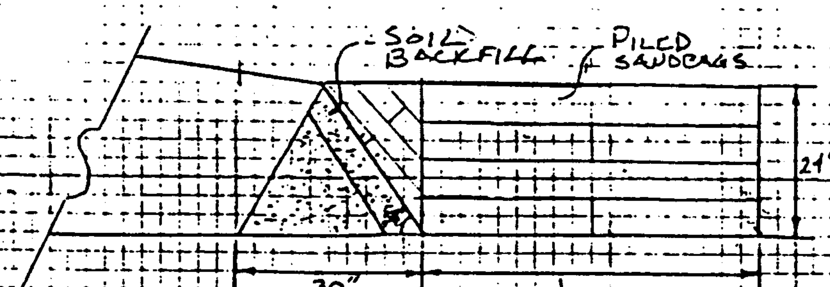
(1) Drawing ____ (2) Doc. No. ____ (3) Page 5 of 7
(4) Building ____ (5) Rev. ____ (6) Job No. ____
(7) Subject 100 AREA SOIL CONTAINER
(8) Originator J.S. BURGESS Date 6/10/93
(9) Checker L. Hyde Date 6/10/93

(10)

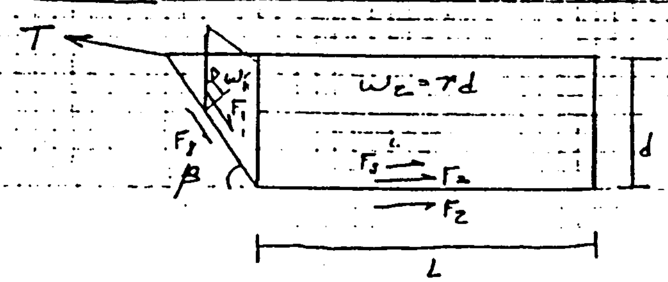
CALCULATE RUNOUT:

- USE SANDBAGS (PREVENTS EROSION)
- LOOSE BACKFILL UNDER WALLS.
- ASSUME FRICTION BETWEEN COVER AND
  - SOIL BACKFILL
  - SOIL AT GRADE
  - SANDBAGS.
- ASSUME FRICTION COEFFICIENT BETWEEN COVER AND SOIL TO BE SAME AS BETWEEN COVER & SANDBAG.

SCHEMATIC



FREE BODY



DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 6 of 7
(4) Building ______ (5) Rev. ______ (6) Job No. ______
(7) Subject 100 AREA SOIL CONTAINER
(8) Originator J. S. BURGESS Date 6/10/93
(9) Checker L. Hyde Date 6/10/93

(10)

$$W_1 = \tfrac{1}{2} d \left(\frac{d}{\tan \beta}\right) \gamma$$

$$W_2 = d \gamma L$$

$$F_1 = W_1 \cos\beta \tan\delta = \left[\tfrac{1}{2} d \left(\frac{d}{\tan\beta}\right)\gamma\right] \cos\beta \tan\delta$$

$$F_1 = \tfrac{1}{2} d^2 \gamma \cos\beta \tan\delta / \tan\beta = \frac{\tfrac{1}{2}(2)^2(100)\cos(54)\tan(20)}{\tan(54)} = \underline{31.09}$$

$$F_2 = W_2 \tan\delta = d\gamma L \tan\delta = 2(100) L \tan(20) = \underline{72.79(L)}$$

$$F_3 = -(T - 2F_1)\sin\beta \tan\delta \Rightarrow \text{LOSS OF FRICTION DUE TO UPLIFT}$$

$$= -T\sin\beta\tan\delta + 2F_1 \sin\beta \tan\delta$$

$$= -T\sin\beta\tan\delta + 2\left(\tfrac{1}{2}\frac{d^2\gamma}{\tan\beta}\right)\sin\beta\tan\delta$$

$$= (-672\sin(54)\tan(20)) + \frac{(2)^2(100)}{\tan(54)}\sin(54)\tan(20) = -112.30$$

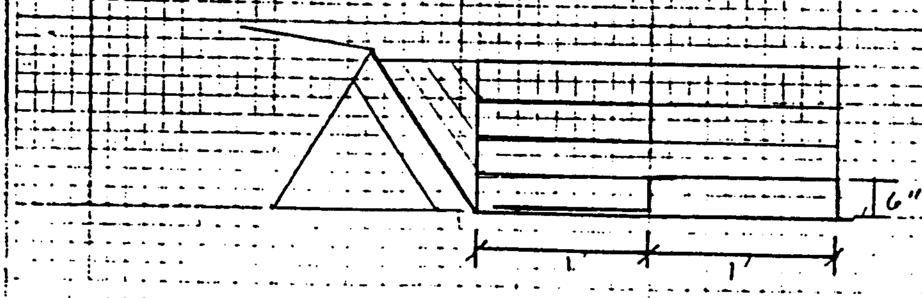
$$\Sigma F_H = 0 \Rightarrow T\cos\beta = 2F_1\cos\beta + 2F_2 + F_3$$

$$672(\cos(54)) = 2(31.09)\cos(54) + 2(72.79)L - 112.30$$

$$L = \frac{672\cos(54) - 2(31.09)\cos(54) + 112.30}{2(72.79)}$$

$L = 3.25' \Rightarrow \boxed{\text{USE 5 ft}}$

AND LAYOUT:



T = TENSION IN PLASTIC (672#)
β = ANGLE OF PLASTIC (54°)
δ = FRICTION ANGLE (20°) [KOERNER p 384]
d = DEPTH OF COVER (2')
γ = DENSITY OF COVER (100 lb/ft³ ⇒ 1'x2'x6" SANDBAGS)
L = LENGTH OF RUNOUT

DESIGN CALCULATION

(1) Drawing ______ (2) Doc. No. ______ (3) Page 7 of 7

(4) Building ______ (5) Rev. ______ (6) Job No. ______

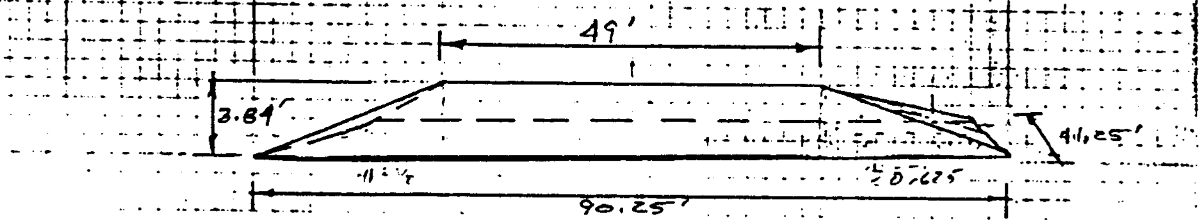
(7) Subject 100 AREA SOIL CONTAINER

(8) Originator J. S. BURGESS Date 6/10/93

(9) Checker L. Hyde Date 6/10/93

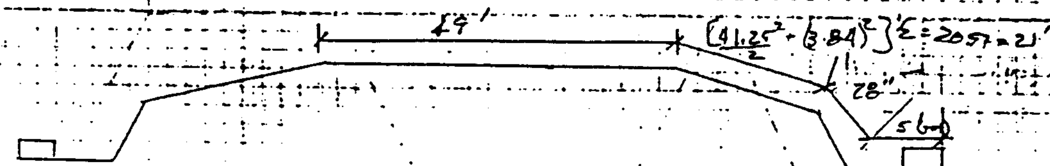
(10)

CALCULATE THE AMOUNT OF COVER MATERIAL



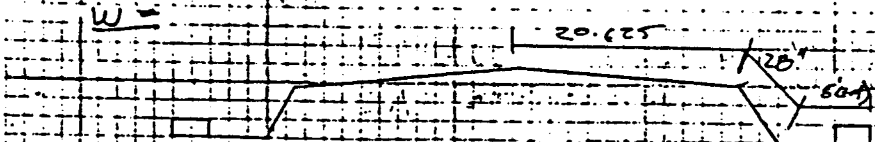
PURCHASE A RECTANGULAR SHEET L×W where:

L =



$L = 2\left[21 + \frac{28}{12} + 5\right] + 49 = 106'$

W =



$2\left[20.625 + \left(\frac{28}{12}\right) + 5\right] = 56'$

$A = L \times W = 106(56) \approx 5936$

Buy a sheet with dimensions GREATER THAN 106 × 56 (ie 110 × 60 = 6600 ft²)

6600 @ 1.14 = \$7524 (for XR-5)

Figure C1. Soil Storage Unit Installation Details 100 Area.

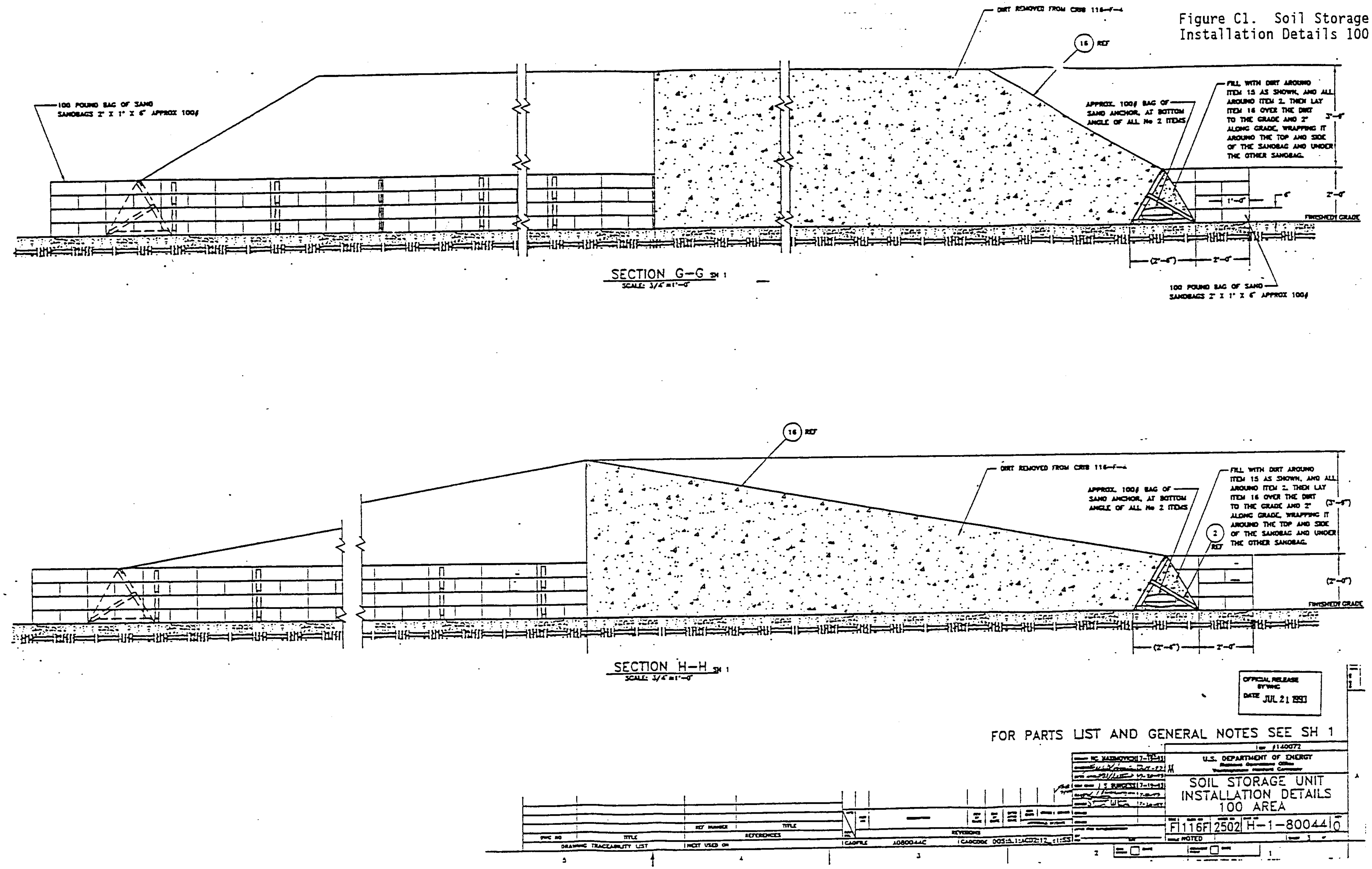


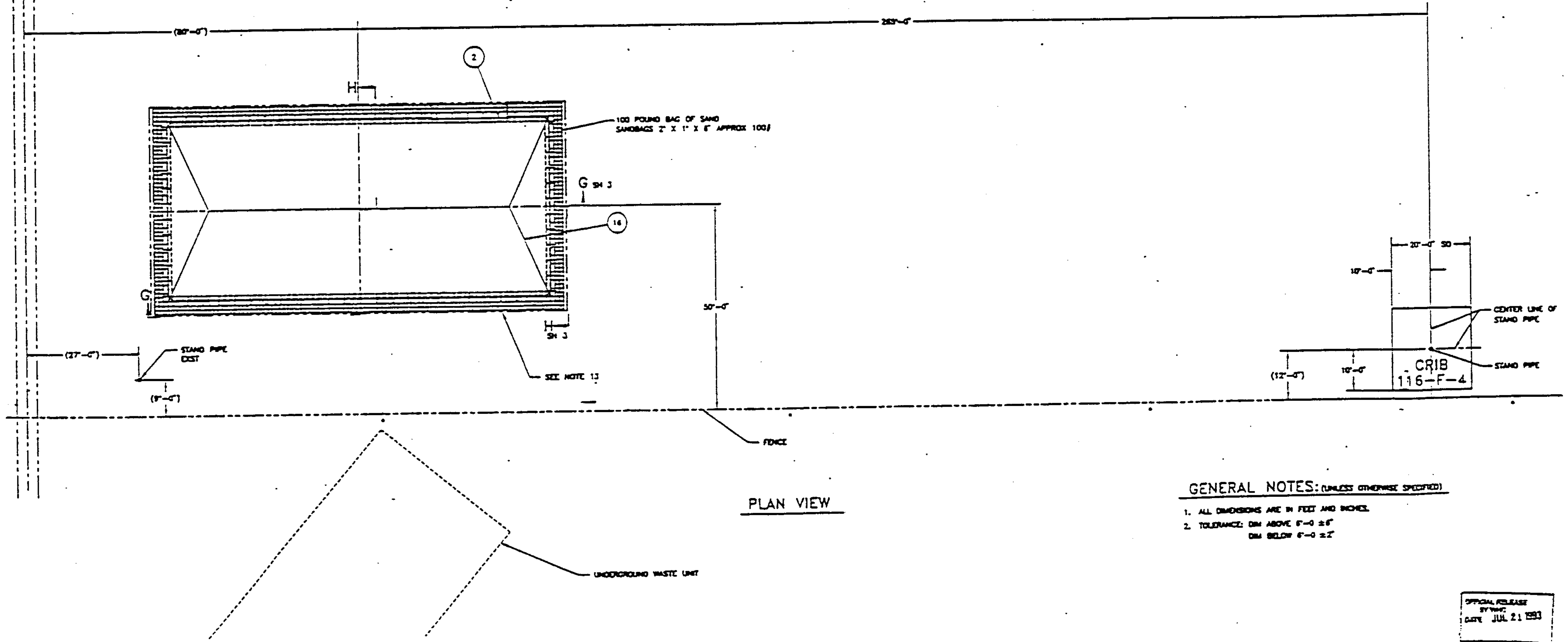
Figure C2. Soil Storage Unit Installation 100 Area.

INSTALLATION INSTRUCTIONS

1. PREPARE 6" MINIMUM CLEAN COMPACTED SAND LEVEL AND FLAT TO RECEIVE ITEM 2.
2. ON THE GROUND, CHALK LINE THE INSIDE DIMENSIONS OF THE TANK.
3. PLACE ITEMS 15, 3 AND 4 ON THE GROUND OUTSIDE OF THE CHALK LINE.
4. STARTING AT ONE CORNER, STAND UP TWO ADJACENT WALL PANELS ITEM 3, WITH THEIR BEND ON THE CHALK LINE, LINE UP THE BOLT HOLES IN THE SUPPORT FRAME ITEM 15 WITH THOSE IN ITEM 3 AND FASTEN TOGETHER WITH THE HEAD OF ITEM 6 FACING INSIDE THE TANK, HAND TIGHTEN ONLY ITEMS 6, 7 AND 8. CONTINUE UNTIL ONE WALL IS ASSEMBLED.
5. ATTACH ITEM 9 OR 10 TO ITEM 15 ON ASSEMBLED WALL BY SLIPPING THE LOOP OF ITEM 9 OR 10 OVER THE ROD ON THE BOTTOM ANGLE OF ITEM 15 AND SLIDE ITEM 9 OR 10 UNDER THE BOTTOM FLANGE OF ITEM 4. STRETCH ITEM 9 OR 10 DIRECTLY ACROSS THE TANK TO THE OPPOSITE ASSEMBLED WALL.
6. AT EACH CORNER ASSEMBLY, REMOVE ITEMS 6, 7 AND 8. SLIP ITEM 4 BETWEEN ITEMS 15 AND 3. ALIGN THEIR BOLT HOLES AND THEN FASTEN ITEMS 15, 3 AND 4 TOGETHER WITH ITEMS 6, 7 AND 8. NOW FASTEN THE TOP FLANGE OF ITEM 3 TO THE TOP OF ITEM 15 WITH ITEMS 6, 7 AND 8. SEE SECTION D—D SH 2.
7. ASSEMBLE THE NEXT WALL AS IN STEPS 3, 4 AND 5. WHEN AN OPPOSITE WALL IS ASSEMBLED, SLIP THE LOOP OF ITEM 9 OR 10 UNDER ITEM 3 AND OVER THE ROD ON THE BOTTOM ANGLE OF ITEM 15.
8. WHEN ALL 4 WALLS ARE ASSEMBLED, FASTENED TOGETHER AND WITH ITEMS 9 AND 10 IN PLACE, TIGHTEN ALL ITEMS 6, 7 AND 8, EXCEPT AT THE TOP OF ITEMS 15 AND 3. COVER THE ENTIRE BOTTOM OF ITEM 2(GROUND AND BOTTOM FLANGE OF ITEM 3) WITH ITEM 11. PLACE ITEM 12 CENTERED ON THE BOTTOM OF THE TANK AND UNFOLD IT TOWARD THE 4 WALLS. ALLOW EXCESS OF ITEM 12 TO LAY OVER EACH WALL AS EVENLY AS POSSIBLE, THEN CUT TO SIZE.
9. AT EACH CORNER, FOLD ITEM 12 INTO A TRIANGLE, AT THE TOP, TO HELP IT LAY FLAT AGAINST ITEM 4. USE ITEM 14 TO FIX THE FOLD IN PLACE.
10. STARTING AT A PAIRE OF ITEMS 15, AT THE TOP FASTENER, REMOVE ITEMS 6, 7 AND 8 BETWEEN THE PAIRE OF ITEMS 15. FOLD ITEM 12 UNDER THE TOP FLANGE OF ITEM 3, USING ITEM 13 TO HOLD ITEM 12 IN PLACE. AT EACH FASTENER LOCATION MAKE A 1/2" DIA HOLE THROUGH ITEM 12. PLACE ITEM 5 OVER ITEM 12, ALIGNING ITS HOLES WITH THE HOLES IN ITEM 15, 3 AND 12. USING REMOVED ITEMS 6, 7 AND 8, FASTEN TOGETHER ITEMS 15, 3, 5 AND 12. REMOVE ITEM 13 AND REPEAT THE PROCEDURE AT EACH ITEM 15 UNTIL ITEM 13 IS SECURED ALL AROUND ITEM 2.
11. PLACE SAND BAGS ON ITEMS 15 AND THEN BACK FILL AROUND ENTIRE STORAGE UNIT AS SHOWN ON SECTION G—G AND SECTION H—H SH 3.
12. AFTER ITEM 2 IS FILLED(WITH EXCAVATED SOIL FROM CRIB 116—F—4), PLACE ITEM 16 OVER THE DIRT AND ITEM 2. ALLOW A MINIMUM OF 5' OF RUNOUT IN THE DIRECTION OF ALL 4 WALLS. LAY ONE ROW OF SANDBAGS 3' IN FROM THE EDGE OF ITEM 16 AND WRAP UP THE REMAINING 3' AROUND SANDBAGS. SEE SECTIONS G—G AND H—H SEE SH 3.
13. SEE DWG H—1—80043 FOR GROUND PREPARATION PRIOR TO ITEM 2 INSTALLATION.

PARTS/MATERIAL LIST

		—010	INSTALLATION, SOIL STORAGE UNIT		1	1
	1	—020	ASSEMBLY, SOIL STORAGE UNIT	TERRASTOR —MCOUTANK INC.	2	2
70		MODEL TS 2424	WALL PANEL		2	3
4			CORNER WALL PANEL		2	4
70			BATTEN STRIP		2	5
148			BOLT Z/P, TRUSS HD 3/8" X 1 1/2" L		2	6
148			HEX NUT Z/P, 3/8"		2	7
148			WASHER Z/P, 3/8"		2	8
12			LONG CABLE, 90'—6" L GALV		2	9
25			SHORT CABLE, 42" L GALV		2	10
2/1			GEOTEXTILE, 7'—6" X 300/7'—6" X 300		2	11
1			LINER, 20 mil PVC 98'—0" X 98'—0"		2	12
4			PLASTIC LOCKING EXTRUSION			13
3			DUCT TAPE — 2" ROLL			14
74		MODEL TS 2424	SUPPORT FRAME	TERRASTOR —MCOUTANK INC.	2	15
	1		COVER MATERIAL, 115' X 85'	XR—5	1	16



1 SOIL STORAGE UNIT INSTALLATION
SHOWN IS ITEM 2 FILLED WITH DIRT AND COVERED WITH ITEM 16. ITEM 16 IS ANCHORED ALONG THE GROUND WITH 100 POUND BAGS OF SAND.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL DIMENSIONS ARE IN FEET AND INCHES.
2. TOLERANCE: DIM ABOVE 6'—0 ±6"
   DIM BELOW 6'—0 ±2"

OFFICIAL RELEASE BY WHC DATE JUL 21 1993

H—1—80015 | 100 AREA TOPOGRAPHICAL MAP
H—1—80043 | SITE PREP FOR SOIL STOR UNIT
REFERENCES
DRAWING TRACEABILITY LIST
REVISIONS
CADCODE 005:5.1:AC02:12 c1:55

U.S. DEPARTMENT OF ENERGY

SOIL STORAGE UNIT INSTALLATION 100 AREA

F | 116F | 2502 | H—1—80044 | 0

Figure C3. Soil Storage Unit Assembly and Details 100 Area.

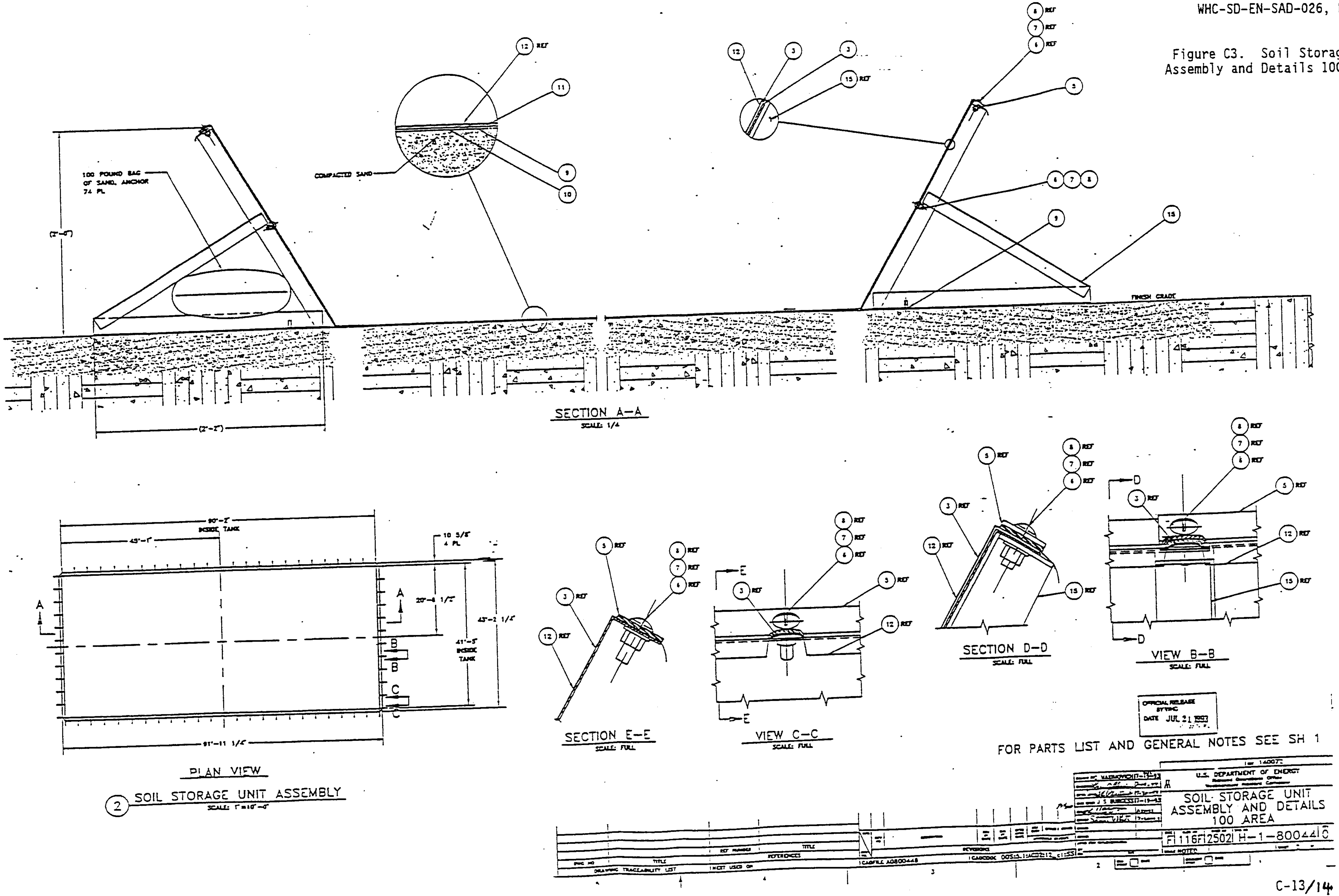
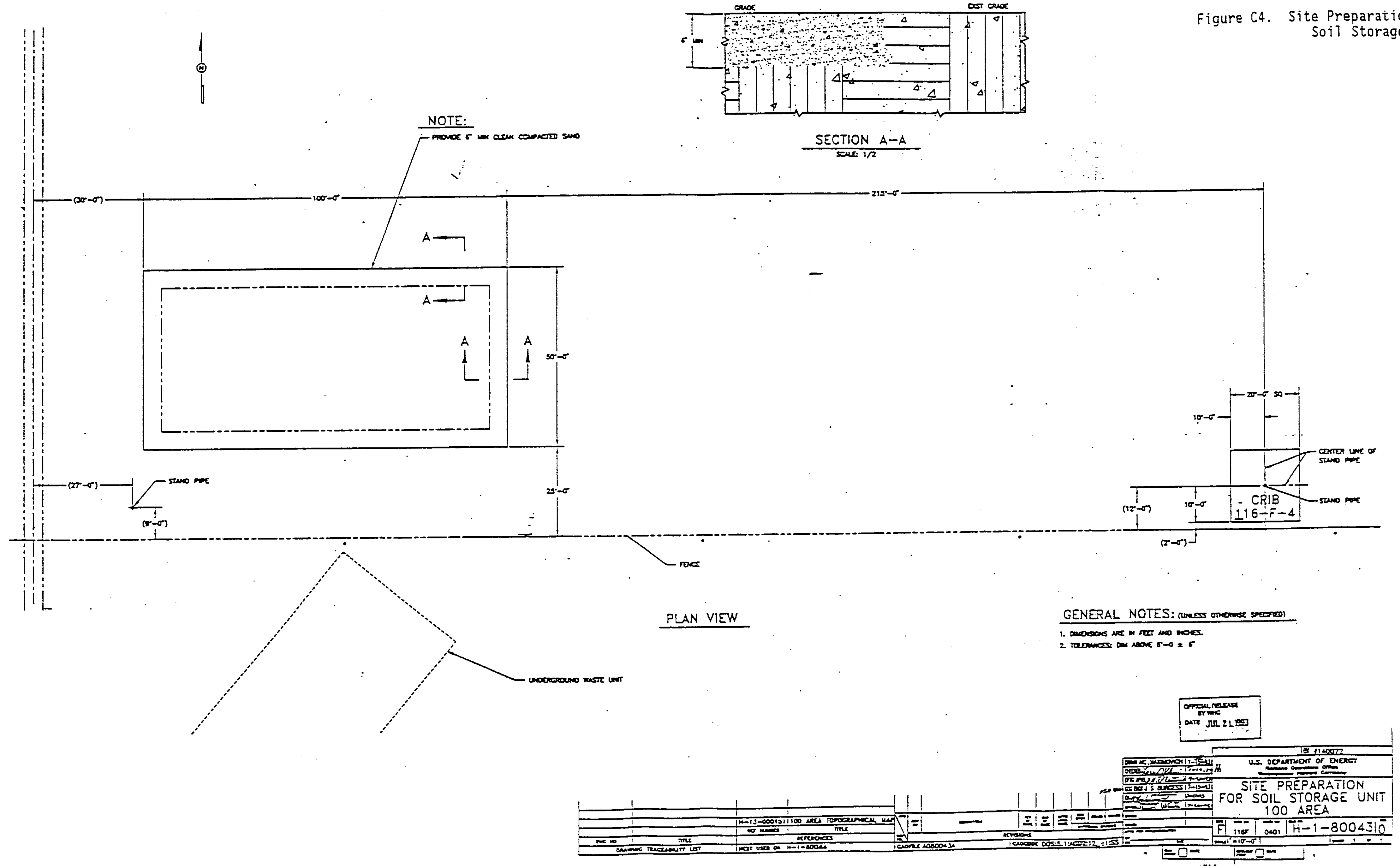


Figure C4. Site Preparation for Soil Storage Unit.



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DISTRIBUTION SHEET

To	From	
Distribution	J. A. Locklair	Page 1 of 1
		Date 7/29/93
Project Title/Work Order: Safety Assessment for Storage of Contaminated Soil at the 100-F Area		EDT No. 141686
		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
M. P. Connelly	H6-06	X			
J. M. Frain	H6-04	X			
K. A. Gano	X0-21	X			
R. L. Hand	H4-16	X			
G. C. Henckel	H6-04	X			
R. P. Henckel	H6-02	X			
D. O. Hess	L4-74	X			
G. S. Hunacek	X0-41	X			
W. L. Johnson	H6-04	X			
N. R. Kerr	H4-67	X			
C. H. Kindle	H6-05	X			
A. J. Knepp	H6-06	X			
A. D. Krug	H6-02	X			
J. A. Locklair	H4-67	X			
J. K. Patterson	H6-27	X			
R. C. Roos	H6-04	X			
C. A. Rowley	H6-04	X			
W. A. Skelly	H6-03	X			
L. C. Swanson	H6-06	X			
S. E. Vukelich	H6-02	X			
D. J. Watson	X0-41	X			
J. J. Zimmer	H4-67	X			
Central Files (Original + 2)	L8-04	X			
Dockett Files (2)	H5-36	X			
EDMC (~~2~~) 1	H6-08	X			
ERSS (3)	H4-67	X			